National Aeronautics and Space Administration

Disclosure of Invention and New Technology (Including Software)

Form Approved O.M.B. NO. 2700-0009

DATE

NT CONTROL NO. (OFFICIAL USE ONLY)

This is an important legal document. Carefully complete and forward to the Patent Representative (NASA in-house innovation) or New Technology Representative (contractor/grant innovation) at NASA. Use of this report form is optional, however, an alternative format must at a minimum contain the information required herein.

In completing each section, use whatever detail deemed appropriate for a "full and complete disclosure." Contractors/Grantees please refer to the New Technology or Patent Rights - Retention by the Contractor clauses. When necessary, attach additional documentation to provide a full, detailed description.

1. DESCRIPTIVE TITLE

Space Network Web Services Interface

2. INNOVATOR(S) (Name(s), Title(s), Phone Number(s), Home Address(es). For non U.S. citizen, include INS Form I-551 No. and expiration date. If multiple innovators, please number.)

Edwin Joseph Stevens
Computer Engineer
301-286-1557 (w)

3. EMPLOYER(S) WHEN INNOVATION MADE (Name and Division)

NASA Goddard Space Flight Center
Networks & Mission Services Project, Code 450
Formerly, Networks Division, Code 530

matrixed from Applied Engineering and Technology Directorate
Ground Systems Hardware Branch,Code 566

4. ADDRESS(ES) (Place of Performance)

NASA Goddard Space Flight Center, B12 C301/N202

5. EMPLOYER STATUS (choose one for each innovator)

_____GE_____ Innovator #1 _____ Innovator #3

_____ Innovator #2 _____ Innovator #4

GE = Government
CU = College or University
NP = Non-Profit Organization
SB = Small Business Firm
LE = Large Entity

6. ORIGIN (check all that apply and supply number(s))

☒ NASA In-house Org. Code __450_____ UPN(s) _____

☐ NASA Grant No. _____ UPN(s) _____

☐ NASA Prime Contract No. _____ UPN(s)_____
Task No. _____ Report No. _____ UPN(s)_____

☐ Subcontractor, Subcontract Tier _____ UPN(s)_____

☐ Joint Effort (NASA prime contractor and NASA in-house) UPN(s)_____

☐ Multiple Contractor Contribution (collaboration of prime contractor and subcontractor) UPN(s)_____

☐ Other (e.g., Space Act or Cooperative Agreement) No. _____ Contractor Reportable Item No. _____

7. NASA CONTRACTING OFFICER'S TECHNICAL REPRESENTATIVE (COTR)
N/A

8. CONTRACT/GRANTEE NEW TECHNOLOGY REPRESENTATIVE (POC) N/A

9. BRIEF ABSTRACT (A general description of the innovation which describes its capabilities, but does not reveal details that would enable duplication or imitation of the innovation.)

The Space Network Web Services Interface (SWSI) is a generic, web-based, cross-platform interface for scheduling Tracking & Data Relay Satellite (TDRS) services, controlling of ground station equipment, and processing of Flight Dynamics Type-8 vectors. The Space Network Web Services Interface acts as a user-friendly front-end to the Network Control Center Data System (NCCDS). The SWSI is part of a larger Space Network enhancement project called Demand Access Service. The SWSI supports all the services provided by the NCCDS: Planning and Scheduling, Real-Time, and Improved Interrange Vectors. The SWSI is designed to be accessed from NASA's Integrated Services Network (NISN) Closed or Open IP Operational Networks (IONET). NISN's Open IONET allows access from the NASA Science Internet and the public Internet, thus allowing cooperation with NASA's university, enterprise, and inter/intra-agency partners.

SECTION I - DESCRIPTION OF THE PROBLEM OR OBJECTIVE THAT MOTIVATED THE INNOVATION'S DEVELOPMENT (Enter as appropriate. A - General description of problem/objective; B - Key or unique problem characteristics; C - Prior art, i.e., prior techniques, methods, materials, or devices performing function of the innovation, or previous means for performing function of software; and D - Disadvantages or limitations of prior art.)

The Network Control Center (NCC) is the scheduling entity for the Space Network (SN). Until now, customers that wished to utilize SN services had to purchase hardware and software that cost between $20K - $30K to handle just Planning and Scheduling services. This does not include the cost needed for hardware and software development for Real-Time and Improved Interrange Vector services. For some low cost, small science projects and missions, that cost is a significant portion or their operations budget. In order make the SN more attractive to small science projects and missions (weather balloons, buoys, etc.), the cost of implementing the SN services had to be reduced. With the SWSI, the cost is reduced to zero.

One of the most attractive concepts about the Space Network Web Services Interface is its cross-platform nature. By utilizing open-standard protocols, the SWSI can be integrated into a customer's Mission Operations Control Center (MOC) at no cost. These standards and protocols allow virtually seamless integration into existing operations. All the hardware and software for the SWSI is maintained by the Space Network, not the customer. The customer accesses the SWSI remotely via a web browser. This is a customer focused solution to scheduling services from the SN. The SWSI offers a low cost alternative to attract new customers.

SECTION II - TECHNICALLY COMPLETE AND EASILY UNDERSTANDABLE DESCRIPTION OF INNOVATION DEVELOPED TO SOLVE THE PROBLEM OR MEET THE OBJECTIVE (Enter as appropriate; existing reports, if available, may form a part of the disclosure, and reference thereto can be made to complete this description: A - Purpose and description of innovation/software; B - identification of component parts or steps, and explanation of mode of operation of innovation/software preferably referring to drawings, sketches, photographs, graphs, flow charts, and/or part or ingredient lists illustrating the components; C - Functional operation; D - Alternate embodiments of the innovation/software; E - Supportive theory; F - Engineering specifications; G - Peripheral equipment; and H - Maintenance, reliability, safety factors.)

To meet the objective of a no cost, cross-platform solution to scheduling the Space Network, the idea of a web-based approach was born. A web-based approach meant that the solution would be cross-platform compatible, since there are web browsers available for almost every computer platform (PC, MAC, Unix, and the like). The web browser provided a reduced hardware dependency for the customer's MOC. All MOC's use either PCs, Macs, or Unix workstation or some combination of the three.

To further reduce the hardware and software costs of interfacing the SN, we would need a computer system to act a the liaison between the customer and the Network Control Center. The computer system is called the Demand Access Processor (DAP). The DAP is the workhouse behind the SWSI. The DAP provides the network, web, and NCC protocol translation to effect a seamless interface to the Network Control Center for scheduling SN services. The Network Control Center Data System currently provides a framework that is a network-based to access SN services. However, each customer is responsible for implementing their own unique interface to the NCCDS based upon the framework provided by the NCCDS. The framework of the SN services on the NCCDS are accessed via unique TCP (Transmission Control Protocol) socket service ports. The SWSI fills the void and provides a user friendly, ready-to-use interface for the customer.

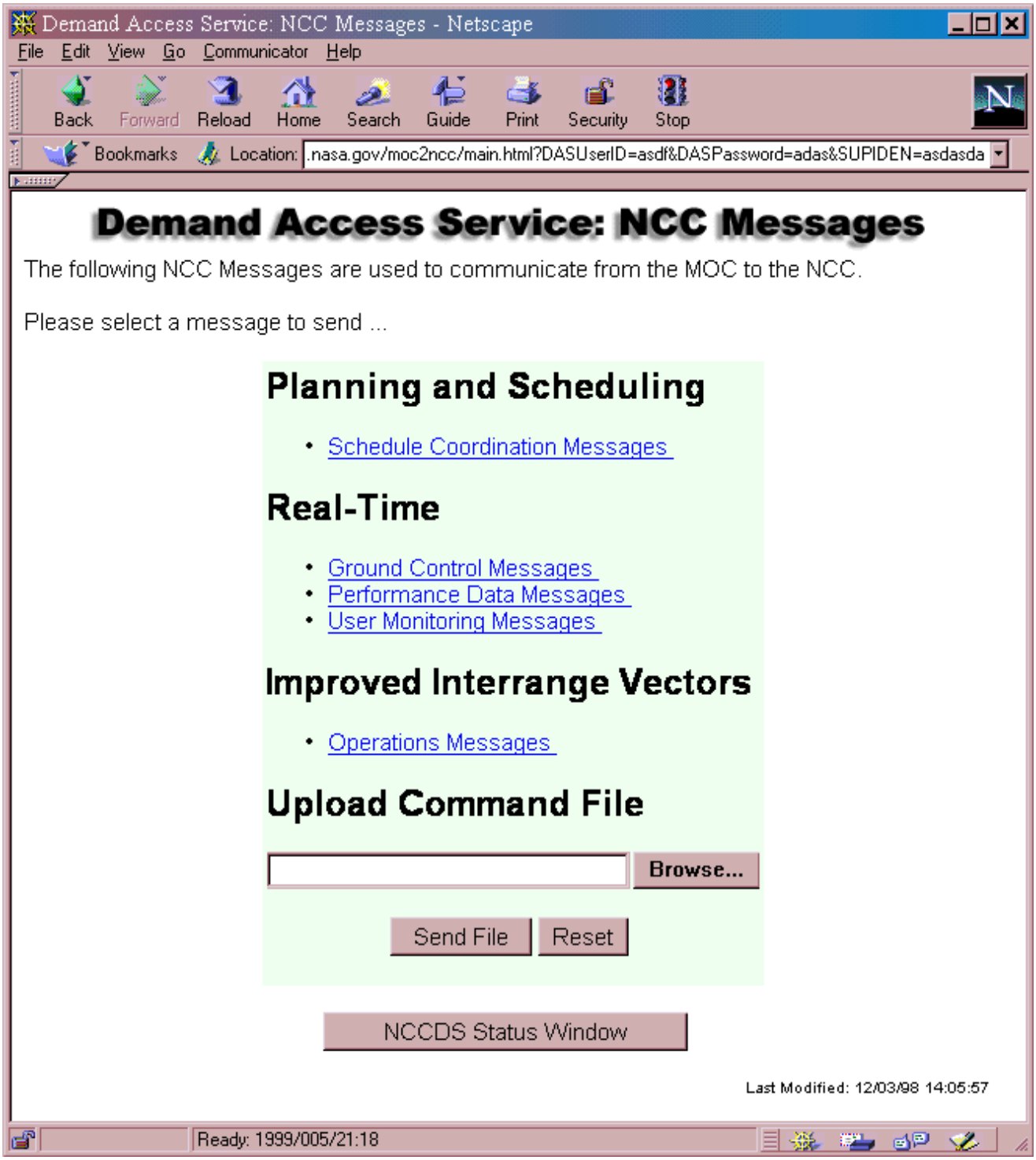

Figure 1. SWSI Intro. Webpage

The SWSI consists of a series HTML (Hypertext Markup Language) pages that provide an "on-line form" approach to scheduling SN services. The HTML pages are hosted from a HTTP (Hypertext Transfer Protocol) server (web server) on the Demand Access Processor. Each page is unique and provides access to specific SN services. For example, there are HTML pages that provide access to Planning and Scheduling, Real-Time, and Improved Interrange Vector services.

Once a customer has filled out and submitted a HTML page pertaining to a specific SN service, the data from the form is verified by a CGI (Common Gateway Interface) script and packaged as an NCCDS data message. This data message is transmitted via TCP socket connection to the Client Manager Server running on the DAP. The Client Manager Server manages all the data between the web browser and the DAP. The Client Manager Server analyzes the data message to determine which SN service on the NCCDS it is destined. Once the destination is determined, the data message is transmitted via socket connection to the XDR (External Data Representation) CODEC (encoder/decoder) Server for encoding and transmitting to the NCCDS. The XDR Server packages the data

in a platform independent manner. The NCCDS expects all data communications between it and a MOC are encoded using XDR. Once the data has been XDR encoded, it is transmitted via socket connection to a unique TCP service port on the NCCDS.

In most cases, the NCCDS will transmit a response to the data message it just received. In cases where the NCCDS does not provide a response, the DAP provides a response to the customer's web browser. This response data message is received by the XDR CODEC Server and XDR decoded (thus the name codec). The decoded data message is transmitted to the Client Manager Server which transmits the response data message back to the customer's web browser. The customer will act accordingly to the response received from the NCCDS. All data messages related to Planning and Scheduling, Real-Time, and Improved Interrange Vector services transmitted via the SWSI follow the path described in Figure 2.

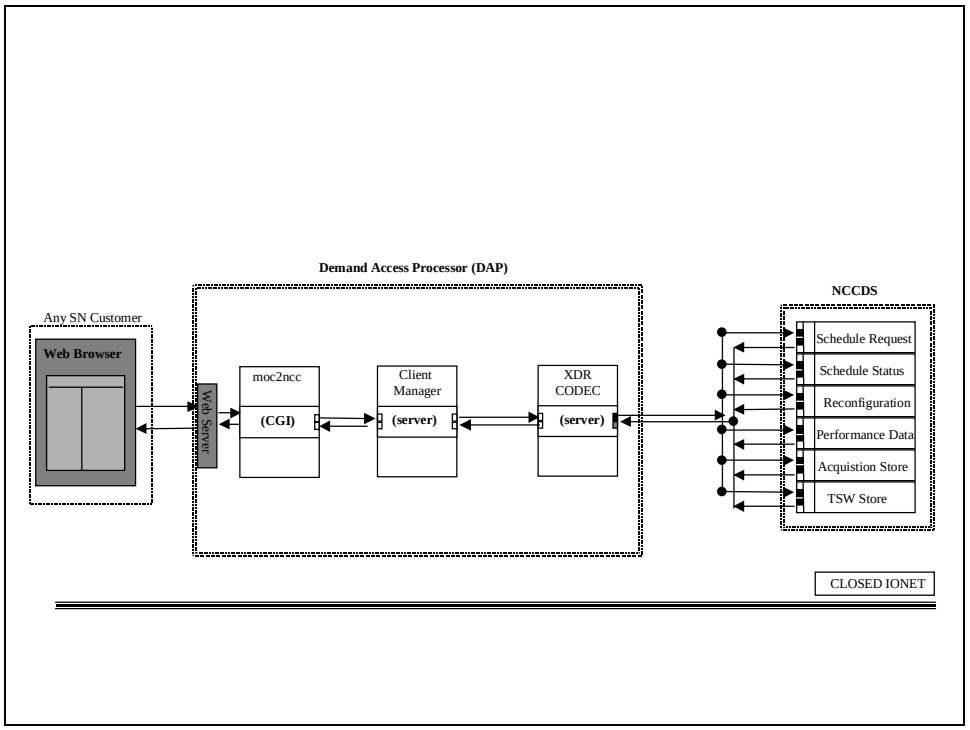

Figure 2. SWSI Architecture

SECTION III - UNIQUE OR NOVEL FEATURES OF THE INNOVATION AND THE RESULTS OR BENEFITS OF ITS APPLICATION (Enter as appropriate: A - Novel or unique features; B - Advantages of innovation/software; C - Development or new conceptual problems; D - Test data and source of error, E - Analysis of capabilities; and F - For software, any re-use or re-engineering of existing code, use of shareware, or use of code owned by a non-federal entity.)

[HTML Pages]

The HTML pages that make up the SWSI are the customer's first encounter with the SN services for TDRS. These pages have been fined tuned to provide a consistent "look and feel" across multiple platforms. To accomplish this we have incorporated the latest Internet standards and technologies such as HTML, Netscape Communication's Javascript language, and Sun Microsystems's Java programming language. HTML is used as the basic interface by which the customer interacts with the web browser. Java and Javascript allow for custom enhancements to the web browser thus providing a user-friendly mechanism for accessing the HTML forms. Using Java and Javascript , HTML forms are automatically filled in and SN calculations are made prior to the customer submitting the form. By integrating these three standard Internet technologies, the SWSI was able to accomplish the objectives of creating user-friendly, cross-platform, low cost interface to scheduling SN services for TDRS.

The Secure Socket Layer (SSL) Protocol has been integrated into the SWSI. SSL is an encryption technology employed on web servers to secure the data transactions between the web browser and the web server. SSL is a proven technology that is currently being used by banks, on-line vendors, and brokerage firms for electronic commerce. SSL allows the customer to send mission sensitive data securely to the NCC via the SWSI.

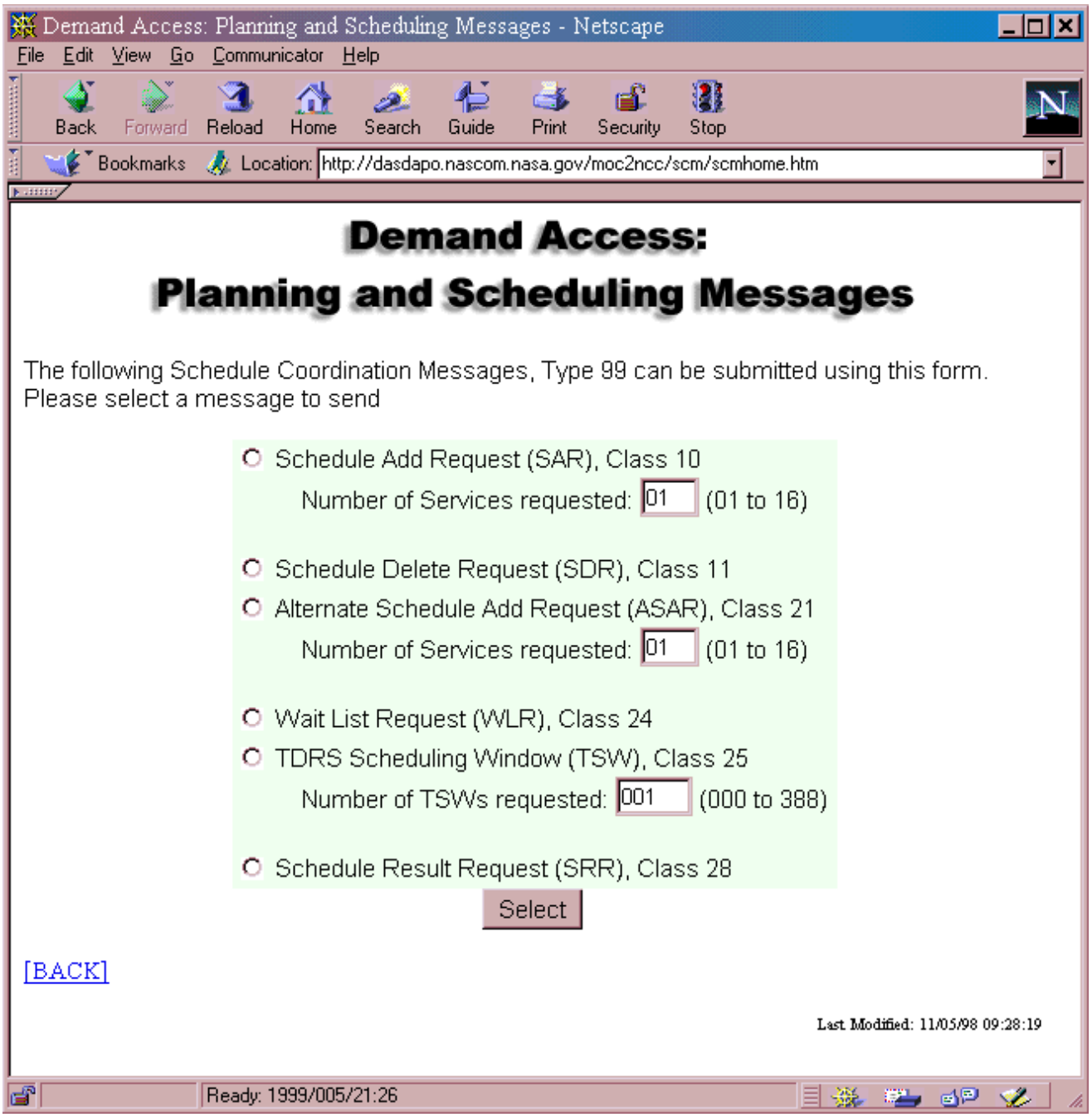

Figure 3. Planning & Scheduling Webpage

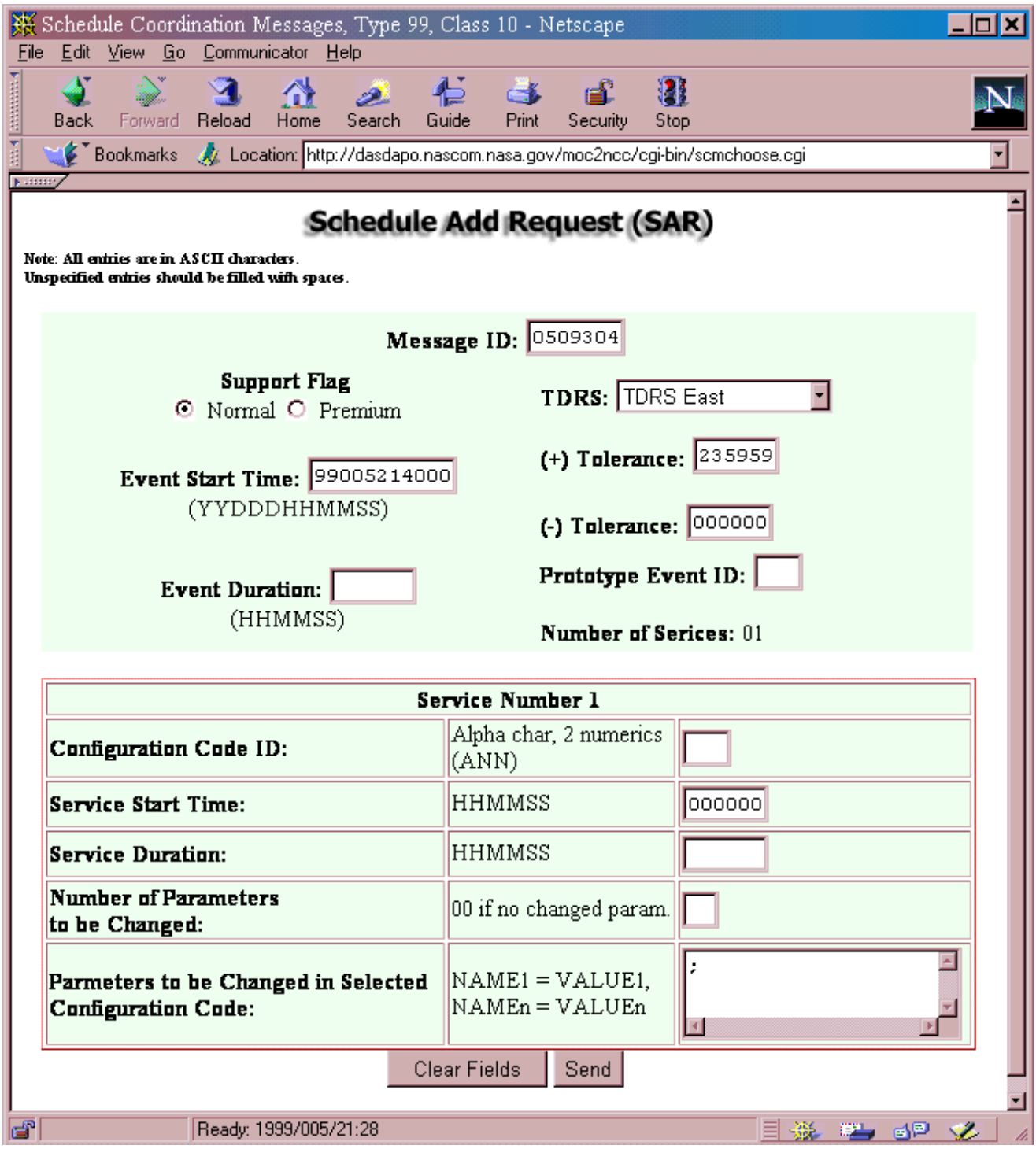

Figure 4. Schedule Add Request Webpage.

[CGI Script]

The Common Gateway Interface scripts (programs) are the life-line to the Demand Access Processor. The CGI scripts act as the gateway between the web browser and the web server and then to the Client Manager Server. The CGI scripts are written in the C programming language. Although CGI scripts do not have to written be in C, the language was chosen for its efficiency and speed as compared to other compiled and interpreted languages. The CGI scripts analyze the data from the HTML pages byte-by-byte to ensure the information entered fits within the specification of the NCCDS protocols for communicating with the SN.

[Client Manager Server]

The Client Manager Server is a standalone network server that runs on the DAP. The server is a multi-client, multi-threaded, connection-oriented server written in the C programming language. The server listens for connection requests on a specific TCP service port. When it hears a connection from the CGI script, it allows a connection and receives the data message transmitted. The data message is analyzed to determine which NCCDS service the message is destined. Then, the message is transmitted to the NCCDS. The NCCDS has the following TCP services available: Schedule Request, Schedule Status, Reconfiguration, Performance Data, Acquisition Storage, and TSW Storage. Each of these services are assigned a unique TCP service port number. The Client Manager Server determines which one of these services the data message should be transmitted. The Client Manager Server logs all incoming and outgoing data messages. This allows the customer to keep track of important mission data and also provides a convenient diagnostic capability.

[XDR CODEC Server]

The XDR CODEC Server is a standalone network server that runs on the DAP. The server is a multi-client, multi-threaded, connection-oriented server written in the C programming Language. The server listens for connection requests on a specific TCP service port. When it hears a connection request from the Client Manager Server, it allows a connection and receives the data message transmitted. The data is XDR encoded for transmission to the NCCDS. Data messages received from the NCCDS in response to previously transmitted messages are XDR decoded and transmitted back to the Client Manager Server.

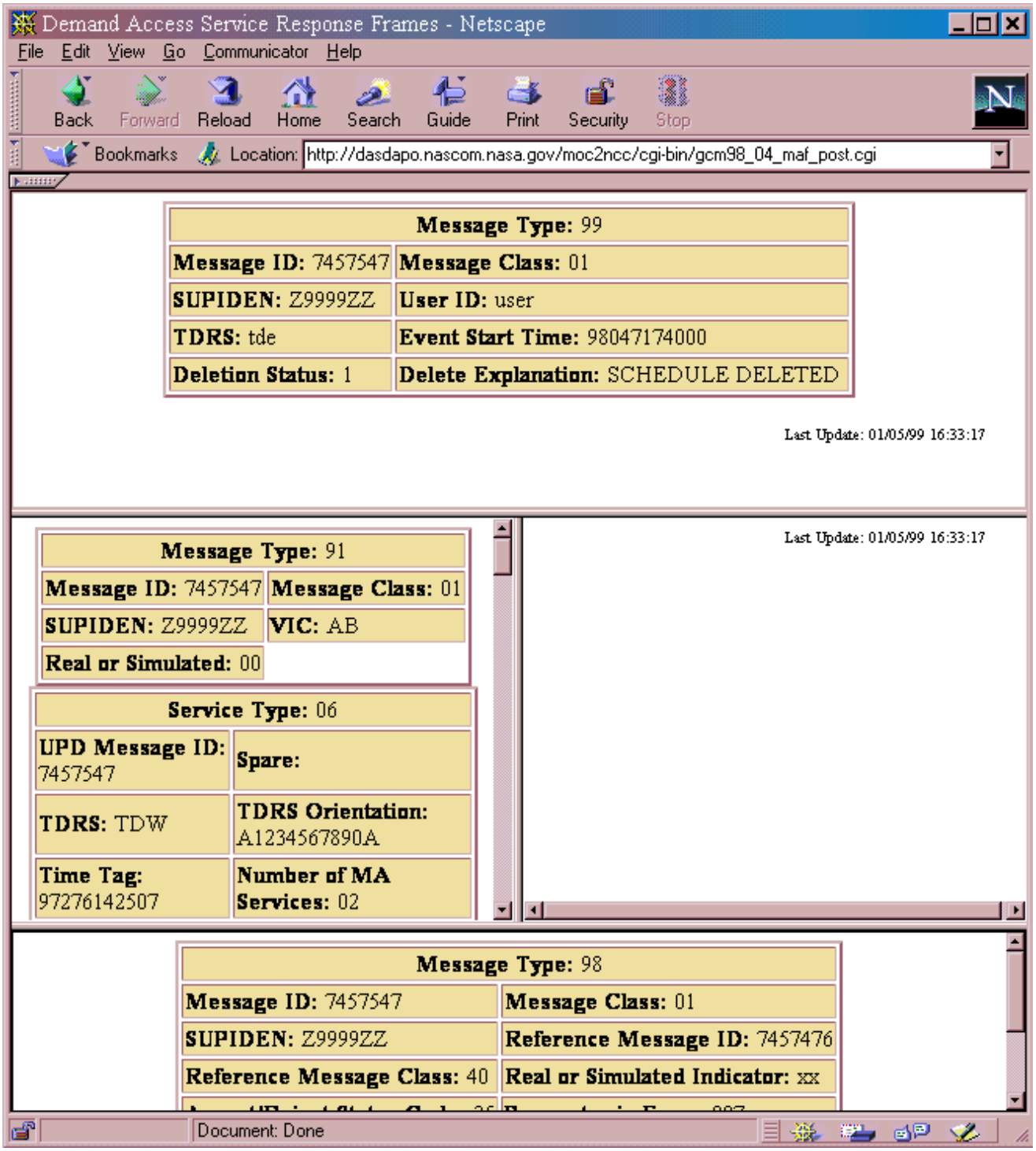

Figure 5. Response Webpage

SECTION IV - SPECULATION REGARDING POTENTIAL COMMERCIAL APPLICATIONS AND POINTS OF CONTACT (Including names of companies producing or using similar products)

There is currently a similar product available for scheduling SN services for TDRS. The User Planning System (UPS) is available to customers to integrate into their MOCs for $20K - $30K. The User Planning System only handles Planning and Scheduling services for the SN. It does not provide an interface for Real-Time or Improved Interrange Vector services. Furthermore, the UPS is not cross-platform compatible since it operates only on the specific HP Unix platform. The User Planning System was developed by Computer Sciences Corporation.

Potentially all current and future customers of the Space Network would benefit from the Space Network Web Services Interface . Customers that would be interested in the SWSI application include, but are not limited to, Hubble Space Telescope, Shuttle, UARS, FUSE, Long Duration Balloon Program, GRO, Gravity Probe-B, PORTCOMM, EOS-PM, and LANDSAT.

Points of Contact
SWSI Project
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Team Member: Edwin Joseph Stevens, Code 566, 301-286-1557, joe.stevens@gsfc.nasa.gov
Demand Access Service Project, http://nmsp.gsfc.nasa.gov/DAS/
Team Lead: Andre Fortin, Code 566, 301-286-7829, andre.fortin@gsfc.nasa.gov

10. ADDITIONAL DOCUMENTATION (Include copies or list below any pertinent documentation which aids in the understanding or application of the innovation (e.g., articles, contractor reports, engineering specs, assembly/manufacturing drawings, parts or ingredients list, operating manuals, test data, assembly/manufacturing procedures, etc).)

TITLE	PAGE	DATE
530-ICD-NCCDS/MOC _____	___ALL_____	May 1998
Space Network User's Guide 530-SNUG Rev. 7_____	_____ALL_____	February 1995

11. DEGREE OF TECHNOLOGICAL SIGNIFICANCE (Which best expresses the degree of technological significance of this innovation?) ___ Modification to Existing Technology **_X_** Substantial Advancement in the Art ___ Major Breakthrough

12. STATE OF DEVELOPMENT

___ Concept Only ___ Design **_X_** Prototype ___ Modification ___ Production Model ___ Used in Current Work

13. PATENT STATUS (Prior patent on/or related to this innovation)

___ Application Filed Application No. _____ Application Date _____

___ Patent Issued Patent No. _____ Issue Date _____

14. INDICATE THE DATES FOR THE APPROXIMATE TIME PERIOD DURING WHICH THIS INNOVATION WAS DEVELOPED (i.e., conceived, constructed, tested, etc.) **03/1996 to present**

15. PREVIOUS OR CONTEMPLATED PUBLICATION OR PUBLIC DISCLOSURE INCLUDING DATES (Provide as applicable: A. - Type of publication or disclosure, e.g., report, conference or seminar, oral presentation; B. - Disclosure by NASA or Contractor/ Grantee; and C. - Title, volume no., page no., and date of publication.) **Presented at the 1998 NASA/GSFC Technology Showcase**

16. QUESTIONS FOR SOFTWARE ONLY

(a.) Using outsiders to beta-test code? ___ Yes **_X_** No If Yes, done under beta-test agreement? ___ Yes ___ No

(b.) Modifications to this software continue by civil servant and/or contractual agreement? **_X_** Yes ___ No

(c.) Previously copyrighted? ___ Yes **_X_** No ___ Unknown If copyrighted, then by whom?

_____

(d.) Were prior versions distribued? ___ Yes **_X_** No If Yes, supply NASA or Contractor contact:

_____

(e.) Contains or is based on code owned by a non-federal entity? ___ Yes **_X_** No ___ Unknown
If Yes, has a license for use been obtained? ___ Yes ___ No ___Unknown

(f.) Has the latest version been distributed without restrictions as to use or disclosure for more than one year?
___ Yes **_X_** No ___Unknown If Yes, date of disclosure: _____

17. NASA IN-HOUSE DISCLOSURES ONLY

STAGE OF DEVELOPMENT	DATE (M/Y)	LOCATION	IDENTIFY PERSONS OR RECORDS SUPPORTING FACT 17a - 17e
a. First disclosure to others	03/1998	1998 NASA/GSFC Technology Showcase	Andre Fortin
b. First sketch, drawing, logic chart or code	02/1996	NASA/GSFC B12	Andre Fortin
c. First written description	03/1996	NASA/GSFC B12	Andre Fortin
d. Completion of first model of full size device (*invention*) or beta version (*software)*	06/1998	NASA/GSFC B12 C301	Andre Fortin
e. First successful operational test (*invention*) or alpha version (*software*)	07/1998	NASA/GSFC B12 C301	Andre Fortin

f. Contribution of innovators (*If jointly developed, provide the contribution of each innovator*)

g. Indicate any past, present, or contemplated government use of the innovation N/A

18. SIGNATURE(S) OF INNOVATOR(S) DATE(S)

TYPED NAMES AND SIGNATURE (*INNOVATOR #1*) Edwin Joseph Stevens	DATE	TYPED NAMES AND SIGNATURE (*INNOVATOR #2*)	DATE
TYPED NAMES AND SIGNATURE (*INNOVATOR #3*)	DATE	TYPED NAMES AND SIGNATURE (*INNOVATOR #4*)	DATE
TYPED NAME AND SIGNATURE (*Witness #1*)	DATE	TYPE NAMES AND SIGNATURE (*Witness #2*)	DATE
NASA > APPROVED / TYPED NAME		SIGNATURE	DATE